HARVARD Kennedy School
JOHN F. KENNEDY SCHOOL OF GOVERNMENT

The Harvard Project on International Climate Agreements

January 2010
Discussion Paper 10-33

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Prepared for
The Harvard Project on International Climate Agreements

THE HARVARD PROJECT ON INTERNATIONAL CLIMATE AGREEMENTS

The goal of the Harvard Project on International Climate Agreements is to help identify key design elements of a scientifically sound, economically rational, and politically pragmatic post-2012 international policy architecture for global climate change. It draws upon leading thinkers from academia, private industry, government, and non-governmental organizations from around the world to construct a small set of promising policy frameworks and then disseminate and discuss the design elements and frameworks with decision-makers. The Project is directed by Robert N. Stavins, Albert Pratt Professor of Business and Government, John F. Kennedy School of Government, Harvard University. For more information, see the Project's website: http://belfercenter.ksg.harvard.edu/climate

Acknowledgements

Major funding for the Harvard Project on International Climate Agreements has been provided by a grant from the Climate Change Initiative of the Doris Duke Charitable Foundation. Additional support has been provided by Christopher P. Kaneb (Harvard AB 1990); the James M. and Cathleen D. Stone Foundation; Paul Josefowitz (Harvard AB 1974, MBA 1977) and Nicholas Josefowitz (Harvard AB 2005); the Enel Endowment for Environmental Economics at Harvard University; the Belfer Center for Science and International Affairs at the Harvard Kennedy School; and the Mossavar-Rahmani Center for Business and Government at the Harvard Kennedy School.

Citation Information

Keohane, Robert O. and David G.Victor. "The Regime Complex for Climate Change" Discussion Paper 2010-33, Cambridge, Mass.: Harvard Project on International Climate Agreements, January 2010.

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The Regime Complex for Climate Change

Robert O. Keohane and David G. Victor[1]

Abstract:

There is no integrated, comprehensive regime governing efforts to limit the extent of climate change. Instead, there is a regime complex: a loosely coupled set of specific regimes. We describe the regime complex for climate change and seek to explain it, using functional, strategic, and organizational arguments. It is likely that such a regime complex will persist: efforts to build an effective, legitimate, and adaptable comprehensive regime are unlikely to succeed. Building on this analysis, we argue that a climate change regime complex, if it meets specified criteria, has advantages over any politically feasible comprehensive regime, particularly with respect to adaptability and flexibility. These characteristics are particularly important in an environment of high uncertainty, such as in the case of climate change where the most demanding international commitments are interdependent yet governments vary widely in their interest and ability to implement such commitments.

[1] Princeton University; University of California, San Diego. We are indebted for comments on an earlier draft to Kal Raustiala, Burton Richter, and participants at a seminar at the Woods Institute, Stanford University, December 3, 2009. Thanks also to Linda Wong for research assistance.

For two decades, governments have struggled to craft a strong, integrated and comprehensive regulatory system for managing climate change. Instead their efforts have produced a varied array of narrowly-focused regulatory regimes—what we call the "regime complex for climate change." The elements of this regime complex are linked more or less closely to one another, sometimes conflicting, sometimes mutually reinforcing. [2]

This paper explores the continuum between comprehensive international regulatory institutions, which are usually focused on a single integrated legal instrument, at one end of a spectrum and highly fragmented arrangements at the other. In-between these two extremes are nested regimes and regime complexes, which are loosely coupled sets of specific regimes. We outline an analytical framework to interpret and begin to explain why regulatory efforts in different issue-areas yield outcomes that vary along this spectrum. Further, we argue that for the case of climate change the structural and interest diversity inherent in contemporary world politics tends to generate the formation of regime complexes rather than a comprehensive, integrated regime. For policy makers keen to make international regulation more effective, we argue that the outcome is not just likely but also may allow for more effective regulation when compared with comprehensive regimes. In settings of high uncertainty and policy flux, regime complexes are not just politically more realistic but they also offer some significant advantages such as flexibility in substantive content and scope.

In Part I we describe the regime complex for climate change, which has not been comprehensively designed but rather has emerged as a result of many state choices at different times and on different specific issues. The description of these institutional arrangements provides almost a textbook illustration of a regime complex.

In Part II we seek to explain why efforts to regulate climate change have yielded a regime complex and also interpret the changes that have occurred over time. We first describe the variety of problems that are addressed by regulatory action on climate change. Different problems imply different tasks; that is, there are functional reasons that help to account for the observed outcome of a regime complex. However, we also consider strategic and organizational explanations, which usefully supplement the functional account.

Our objective is to think about international regimes and regime complexes in ways that could facilitate effective action on the pressing contemporary set of problems surrounding climate change. In Part III we therefore explore some implications for policy from these insights. In our view pressures favoring regime complexes over integrated regimes are strong. Efforts to create an integrated, comprehensive regime are therefore unlikely to be successful and may even divert attention from more practical efforts to create regime complexes. Furthermore, such regime complexes have some advantages over coherent, integrated regimes. They may well be more flexible and adaptable—a point we illustrate with examples from international emissions trading, forestry and land-use innovation, accommodation of border tax adjustments, and

[1]Raustiala and Victor 2004, 295.

cooperation on technology policy. Yet the fact that such regimes are comprised of loosely coupled elements does not *necessarily* make them superior. They still need to meet standards of coherence, effectiveness, determinacy, sustainability, accountability, and epistemic quality.

I. The Regime Complex for Climate Change

In this section we first discuss the concept of a "regime complex," then describe the contemporary international institutional arrangements for coping with climate change in these terms.

The Concept of a "Regime Complex"

States construct international regimes on the basis of their interests. Under conditions of complex interdependence, state interests will reflect the interests of the major constituencies that exert influence over state leaders. The weighting of these interests in determining international outcomes depends on the power resources, relevant to the issue-area, that are available to the states involved. Power will reflect asymmetrical interdependence: bargaining power will depend both on the impact of one's own decisions on others (a reflection of size) and on favorable asymmetries in interdependence leading to better default (no-agreement) positions for the state.[3] Information and beliefs are also important.[4]

All of these fundamental features of the situation – interests, power, information, and beliefs – change over time, at different rates in different countries, and on different issues. Since interests and power vary among states governments often form "clubs," and seek to create club goods, limiting benefits to states that do not share their interests or seek to act as free riders.[5] As a result, international regimes vary in membership. Furthermore, international regimes often come about not through deliberate decision-making at one international conference, but rather emerge as a result of "codifying informal rights and rules that have evolved over time through a process of converging expectations or tacit bargaining."[6] That is, they emerge in path-dependent, historically-shaped ways.[7]

Our focus in this paper is on what emerges from the process. If there is agreement on regulatory arrangements, an international regime or regimes results. In thinking about the resulting regimes and regime complexes, it is helpful to imagine a continuum. At one extreme are fully integrated institutions that impose regulation through comprehensive, hierarchical rules. At the other extreme are highly fragmented collections of institutions with no identifiable core and weak or nonexistent linkages

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[3] Keohane and Nye 1977.
[4] Keohane 1984; O'Neill 1999.
[5] Keohane and Nye 2001; Kahler and Lake 2003. On club goods see Cornes and Sandler 1996. The club argument can also be extended to relationships among sub-units of governments, which can form governmental networks. See Slaughter 2004.
[6] Young 1997, 10.
[7] Pierson 2000.

between regime elements. In between is a wide range that includes nested (semi-hierarchical) regimes with identifiable cores and non-hierarchical but loosely coupled systems of institutions. [8] What we are calling "regime complexes" are arrangements of the loosely coupled variety located somewhere in the middle of this continuum: there are connections between the specific and relatively narrow regimes, but no overall architecture that structures the whole set.

We expect comprehensive regimes when interests of essentially all the most powerful actors are sufficiently similar, across a broad issue-area, that they "demand" international institutions as ways to achieve their objectives through reducing contracting costs, providing focal points, enhancing information and therefore credibility, and monitoring compliance.[9] Powerful demand by all key players around a common objective yields a single institution and no viable rivals. Institutional design can also encourage integration. The evolution of the GATT, for example, encouraged (until about a decade ago) investment in a single integrated regime because private benefits from the regime were large and readily extended to all members through the norms of most favored nation status and reciprocity.

But often several narrow regimes coexist in the same issue-area without clear hierarchy. Under these conditions, which favor fragmentation, conflicts between individual regulatory elements may be especially likely to arise. Even if the conflicts are not acute, the existence of different forums frequently leads to forum-shifting: "moving a regulatory agenda from one organization to another; abandoning an organization; or pursuing the same agenda in more than one organization."[10] To solve problems in each forum, governments try to link issues in the forum to other issues in ways that will help them achieve their objectives.[11] Yet institutional design may favor continued fragmentation, such as when it is administratively difficult to create extensive links between distinct regulatory elements. The result, as we discuss in more detail below, can be a regime complex. When patterns of interests (shaped by beliefs, constrained by information and weighted by power) diverge to a greater or lesser extent, major actors may prefer a regime complex to any feasible comprehensive, highly integrated, institution.

In the rest of this paper we explore how the forces for integration or fragmentation interact, using the example of climate change. The climate change regime complex, as we will show, is a loosely coupled system of institutions—it has no clear hierarchy or core yet many of its elements are linked in complementary ways.

[8] For more on the different species of regime complexes see Alter and Meunier 2009 and the symposium they introduce.
[9] Keohane 1984.
[10] Braithwaite and Drahos 2000, 29. See also Busch 2007.
[11] Alter and Meunier 2009.

The Climate Change Regime Complex

We now turn to climate change. The climate change issue-area is governed by a regime complex rather than a comprehensive regime or a fully fragmented, dispersed set of institutions. The most visible efforts to create climate institutions cluster around the United Nations Framework Convention on Climate Change (UNFCCC). By design the UNFCCC is nearly universal in membership. It spawned the Kyoto protocol with the aim of being a thickening and comprehensive regime. In practice, because Kyoto placed no obligations on developing countries and because the United States never ratified the agreement, its practical effect was narrow, thin and ultimately symbolic.[12] The Kyoto Protocol is now being renegotiated and extended under the auspices of the UNFCCC, in addition to which several other clusters of institutional efforts are taking shape. None is organized in a hierarchy. Figure 1 illustrates the arrangements. At this writing it is not clear which of these efforts will gain traction.

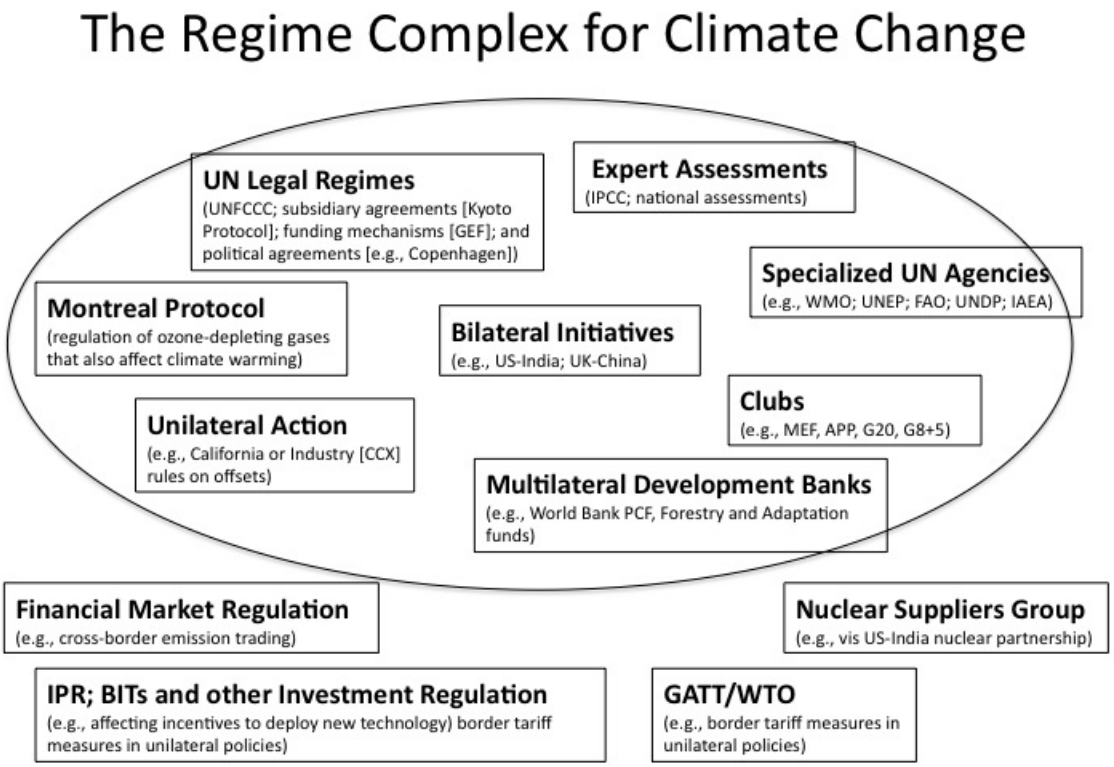
The Regime Complex for Climate Change
UN Legal Regimes
(UNFCCC; subsidiary agreements [Kyoto Protocol]; funding mechanisms [GEF]; and political agreements [e.g., Copenhagen])
Expert Assessments
(IPCC; national assessments)
Specialized UN Agencies
(e.g., WMO; UNEP; FAO; UNDP; IAEA)
Montreal Protocol
(regulation of ozone-depleting gases that also affect climate warming)
Bilateral Initiatives
(e.g., US-India; UK-China)
Clubs
(e.g., MEF, APP, G20, G8+5)
Unilateral Action
(e.g., California or Industry [CCX] rules on offsets)
Multilateral Development Banks
(e.g., World Bank PCF, Forestry and Adaptation funds)
Financial Market Regulation
(e.g., cross-border emission trading)
Nuclear Suppliers Group
(e.g., vis US-India nuclear partnership)
IPR; BITs and other Investment Regulation
(e.g., affecting incentives to deploy new technology) border tariff measures in unilateral policies)
GATT/WTO
(e.g., border tariff measures in unilateral policies)

Figure 1: The Regime Complex for Managing Climate change. Boxes show the main institutional elements and initiatives that comprise the climate change regime complex. (For a thorough recent description of many elements of the regime complex se Michonski and Levi, 2010). Elements inside the oval represent forums where substantial rule making has occurred, focused on one or more of the tasks needed to manage climate change; elements outside are areas where climate rule making has required additional, supporting rules.

[12] For an early discussion, see Victor 2001.

Several governments have tried to create smaller "clubs" of key countries that could cooperate on climate change issues. Some of these club efforts are *de novo*, which has required club leaders to incur the costs of organization. Others build on existing institutions, which offers the advantage of lower transaction costs but the disadvantage that membership and expectations are already largely formed. We have identified four nascent club-making efforts. The first, created by the United States under George W. Bush in the wake of criticism about the US decision to abandon the Kyoto treaty, is the Asia Pacific Partnership (APP). Six countries on the Asian rim agreed to cooperate on research and deployment of new low-carbon technologies. APP was intended to chart an alternative path to the Kyoto process while also forging special relationships that might lead to commercially viable deployment of low-carbon technologies. All of its members had in common their lack of adherence to strict targets within the Kyoto treaty—two were industrialized countries (the U.S. and Australia, which also rejected Kyoto but has since changed course with a new government) and four were developing countries, among them China and India. In practice, the U.S. never fully realized the potential of its APP club, in part because pockets of the Bush administration remained hostile to any effort to reduce global warming and thus the private goods offered through the APP were not widely seen as credible.

Soon after creating the APP the Bush administration saw that its club was too small, and it led to the formation of the Major Emitters Forum (MEF) in 2007. This club of sixteen states first met before the Bali conference and aimed to set its own rules for a more flexible strategy to reduce emissions. The MEF exists to this day—expanded to seventeen members and renamed as the Major Economies Forum on Energy and Climate Change. In parallel, the G8 club took up the climate issue, which has been relatively easy since the G8 already existed and was in perennial search of agenda items. Every G8 meeting during the last five years included a prominent statement on climate change. Each G8 meeting has also included a stepchild session where G8 leaders met with leaders from the five most pivotal developing countries (the so-called "G8+5"); climate change has always been on their agenda.

Finally, the G20, a forum originally created by finance ministers in the wake of the Asian financial crisis in the late 1990s, in 2009 replaced the G8 on non-security issues, so has become the major forum for the high-level discussion of energy and climate issues. Because the G20 engages finance and industry officials much more readily than other clubs such as the MEF and the APP it has been a locus for some progress on low-cost measures that help reduce emissions. For example, the September 2009 G20 summit in Pittsburgh found it difficult to gain traction on the broad issue of regulating warming gases—energy was just one of 17 issues on an agenda that included more urgent troubles such as financial market regulation—but it did forge an agreement to reduce fossil fuel subsidies.[13] With lower subsidies, fuel users see more accurate prices and will use fuel in more frugal ways, leading to lower emissions.

[13] "The Pittsburgh Summit: Key Accomplishments," http://www.pittsburghsummit.gov/resources/129665.htm.

In addition to these clubs, nearly all the large industrialized countries that are most worried about climate change have created bilateral deals of various types. The U.K. has created a bilateral partnership with China to test advanced coal combustion technologies. Australia and China also forged such a deal, and a competition is now under way among essentially all western governments to strike the most relevant arrangements with China. The U.S. has created a variety of partnerships with China—some of which have failed, such as the "FutureGen" scheme to build advanced coal plants cancelled at the end of the Bush administration (then restarted) and no longer seen as credible in China. It has also forged a major partnership to give India access to fissile material and technology that had been unavailable because India was not part of the nuclear nonproliferation treaty. That arrangement, which will lead to massive reductions in India's emissions relative to the expected level, required in turn new deals with the Nuclear Suppliers Group as well as difficult domestic negotiations in both India and the United States. [14]

Quite distinct from the regulatory efforts on climate change are the efforts to assess the scientific basis for concern about unchecked climate change—notably through the Intergovernmental Panel on Climate Change (IPCC). IPCC's membership is universal, and under that broad umbrella it sponsors in-depth scientific reviews that provide the public good of consensus knowledge. IPCC also entertains requests, which come at arm's length, from other institutions such as the UNFCCC to provide technical information, such as the reporting procedures for emissions inventories. In parallel with the multilateral IPCC process several governments have undertaken their own assessments—often looking expansively not just at impacts at home but also around the world. The U.K.'s "Stern review" is one example.

While most efforts to set targets for warming emissions have focused on the UNFCCC, other regulatory treaties have a big impact on emissions of these gases. Indeed, some studies have concluded that the Montreal Protocol on Substances that Deplete the Ozone Layer has actually had a much bigger impact than the Kyoto Protocol on warming gases.[15] Frustrated by lack of progress in the UNFCCC system, some governments have explored fuller use of the Montreal Protocol to cut some of the specialized industrial gases that are linked to the ozone layer problem and also contribute to climate change. Several regional air pollution institutions may ultimately play an important role in climate change as well. Some of the pollutants they regulate mask warming—notably sulfate particles (which cause acid rain and thus are regulated, but they also make clouds brighter and thus dampen warming). Increased attention is now focused on particulate pollution, which is presently regulated because it contributes to local air pollution; there is mounting evidence that particulate pollution (also called "black carbon") is a big cause of climate change.[16]

[14] For details on the potential reductions from a wide array of Indian policy initiatives, including this one, see Rai and Victor 2009.
[15] Velders et al. 2007.
[16] See Ramanathan and Carmichael 2008 among many other papers by Ramanathan and colleagues.

Existing multilateral institutions, notably the World Bank, have also been a locus of institution building on climate change. For example, the World Bank sponsored the Prototype Carbon Fund (PCF) in the late 1990s to channel early investment into the Kyoto Protocol's Clean Development Mechanism (CDM)—the mechanism that encourages investment in low-emission technologies and practices in developing countries. The experience with PCF projects, in turn, helped speed the process of designing rules for the CDM and probably raised the quality of the subsequent CDM projects. The Bank, working with other multilateral institutions and through the Global Environment Facility (GEF), also manages the formal financial mechanisms that pay for developing country participation under the UNFCCC and the Kyoto treaty. (It plays a similar role in other multilateral environmental institutions.) In addition to these efforts, which are formally subordinate to the UNFCCC institutions, the Bank also manages several other funding windows that are formally distinct. It is organizing a large fund to invest in projects that reduce deforestation—this effort has advanced even as formal UNFCCC-based talks on deforestation have worked on these same issues in parallel. The Bank has also created a special fund to help countries adapt to the effects of climate change. And perhaps most important is that the Bank has adopted an across-the-board effort to bring climate change concerns into its main lending and granting activities, thus creating much larger leverage on the money that flows into agriculture, power plants, infrastructure and other investments that cause or are affected by the changing climate. [17]

Beyond these efforts that involve formal coordination in some manner, there are also unilateral initiatives that are intended to encourage changes in behavior not just within the entity making the initiative but also in other jurisdictions. For example, frustration at the slow progress of U.S. federal legislation has led at least two sub-units within the United States to adopt their own limits on emissions—California (under AB32) and the northeastern states (under the Regional Greenhouse Gas Initiative, or RGGI). Both those systems include "docking" provisions for international trading, which would allow these states to set rules that created valuable private goods (emission credits) that firms could generate in other countries. At this writing, the RGGI system is struggling to remain relevant since its auctions have yielded prices that are so low they are unlikely to have much impact on behavior; the California system, by contrast, is likely to be more robust and may even remain in place alongside any U.S. federal legislation.[18]

Thus there is a wide array of activities under way that, mostly, are not organized hierarchically. Some are attached to existing narrow and deep regimes—such as bilateral initiatives that are making it easier for India to obtain fissile material, or the efforts to mainstream climate change issues within the existing robust World Bank system for lending. Others involve nascent institutions, such as the emerging markets for carbon offsets and trading, that in some cases have not progressed beyond initial modest efforts (e.g., the RGGI market) while others are becoming deep quickly (e.g., the EU's emission trading scheme and probably the California scheme). These efforts are akin to the

[17] See, e.g., World Bank 2008 and World Bank Independent Evaluation Group 2009.
[18] For example, see section 96400 in California Air Resources Board 2009. By contrast, see auction prices for RGGI at www.rggi.org.

Cambrian explosion—a wide array of diverse institutional forms emerges, and through selection and accident a few will be chosen.

II. Solving Climate Change Cooperation Problems

Climate change is politically a difficult problem for three fundamental reasons. First, it is a global problem, whose solution cannot be achieved through the efforts of any single state or small group of states. Second, the negative effects of climate change are not observable now, but are only expected to occur some years in the future. It is therefore an intergenerational problem: present generations are expected to pay costs for the benefit of their successes two or more generations into the future. Political leaders seeking effective action on climate change have to persuade their publics both that their own actions can make significant difference, partly by encouraging other countries to act, and that costs borne today are in the interests of successor generations. Third, changing practices with respect to climate change requires changes in the habits of billions of people, as well as organizations such as firms; but practical policies to generate incentives for these behavioral changes require action by governments that, in many cases, may not have the interest or ability to exert much influence on their subjects.

These difficulties are accompanied at a more specific level by *problem diversity:* the specific problems inherent in the concept of "climate change" are enormously diverse. The diversity of problems is, in turn, associated with parallel diverse political patterns of interests, power, information and beliefs. Both because of problem diversity and the associated political diversity, and because of the difficulty of moving away from an equilibrium that has been established, we do not expect an integrated and comprehensive climate change regime to be instituted in the foreseeable future.

Diverse Problems, Diverse Institutions

The diversity of institutional efforts suggests, as summarized in Figure 2, that the "climate change problem" is actually many distinct problems—each with its own attributes, administrative challenges and distinctive political constituencies. Some of these problems are loosely coupled and some are tightly coupled. For example, funds to compensate developing countries for the cost of adapting to climate change are mobilized, in part, by taxing the flow of emission offset transactions under the CDM—along with a diverse array of other funding sources. And the majority of funds used to pay for emission controls in developing countries arise from the CDM. Many of the problems that, together, comprise the cooperative challenge of climate change are marked by extreme difficulties in crafting effective cooperation because free riders can undermine collective efforts. In these settings—where the issue of "climate change" is actually many distinct problems, where couplings vary, and where institutional design must overcome barriers to collective action—it is not surprising that we observe variety of institutional forms. Especially in the early stages of building a regime, many institutions are tried; only some of them thrive.

Tasks: Nature of the problem:	Provide credible information about climate change dangers and options:	Monitor policies	Create and maintain emissions trading systems	Create and maintain institutions for investments, including technology	Create and maintain institutions for adaptation	Create and maintain institutions for solar radiation management ("geoengineering")
Manage a CPR.		x	x			
Create a public good	X	x	x	x	x	
Provide compensation				x	x	
Prevent a public bad						x

Figure 2: Climate Change Cooperation Problems and Tasks

Emissions control involves common pool resources, or CPRs. A CPR is a "global commons": a resource that it is difficult or impossible to exclude others from enjoying but that is degraded by use. In this case, the desired global commons is an atmosphere with a lower concentration of greenhouse gases than would otherwise be the case. (The UNFCCC sets the goal as avoiding "dangerous" climate change, but nobody has been able to agree on what that term actually means.) Actions to cope with a CPR face a serious collective action problem. CPRs are therefore not self-managing; promoting sustained cooperation requires formal institutions involving rules and social norms.[19] Since emissions control has the characteristics of a CPR, in the absence of further institutions many benefits of emissions control will be nonexcludable: that is, available even to those who do not control their own emissions. In Figure 2 we have identified two problems of climate change associated with managing a CPR: providing credible information about dangers, benefits and options; and setting, monitoring, and enforcing meaningful state policy efforts.

Very closely related to the CPR problems are issues involving the supply of public goods. Those public goods include institutions and reliable information. Other public goods include R&D on technologies that allow for reducing emissions and adaptation to climate change—while some of the knowledge that comes from R&D yields private benefits, such as lucrative new products, the most important ideas usually diffuse widely. There is no threatened common pool resource, but incentives to free-ride are nevertheless strong. CPR and public goods problems both require careful design of contracts—often relying on institutions to help lower the cost of contracting, monitoring,

[19] Ostrom 1990.

and enforcement—because deep cooperation requires overcoming incentives to free ride that arise whenever goods are not excludable

Some climate change problems involve re-aligning incentives when parties do not perceive an immediate interest in an outcome that others favor. In these cases, compensation may be needed. Reluctant governments may demand side-payments before they will agree to cooperate. For example, Russia and essentially all developing countries at the Kyoto talks were unwilling to agree on measures limiting emissions in the absence of payments through mechanisms such as the CDM. Compensation may also be needed for private actors, such as firms that bear the cost of installing costly new technologies or of investing in public goods. Provision for compensation provides one of the most important linkages between emission trading systems and cross-border investments.

Finally, those forms of geoengineering that involve measures to limit or deflect energy from entering the atmosphere pose entirely different political and institutional problems. With respect to solar radiation management, as these measures are called, the problem is that action by one or a few actors may be too easy and need to be prevented.[20] That is, solar radiation management involves a problem that is essentially the analytic opposite of the CPR problem: how to make it *more difficult* rather than easier to act.

Managing CPR Problems: Limiting Emissions

Many of the distinct problem types presented in figure 2 are difficult to solve. Here we focus on the one that is most pivotal to taming the impacts of global warming: the protection of the CPR of a safe atmosphere. What's at stake is the mixture of warming gases in the atmosphere that produces a climate to which humans and other existing forms of life have adjusted. This resource is being degraded as a result of the aggregation of individual actions. Yet people, firms and states that fail to limit their greenhouse gas emissions cannot feasibly be excluded from the benefits of a benign climate, and those that do act to limit their emissions do not individually benefit thereby.

On the face of it, CPR problems are difficult to solve and much of the early literature on this question was pessimistic.[21] Yet practical solutions to seemingly intractable CPR problems can emerge--usually involving strategies that change incentives.[22] Put differently, the CPR can be transformed into a different type of problem that is easier to solve. At least four approaches have been followed, which we discuss in order—starting with approaches for which a capable regulatory regime is not needed to solve the CPR problem, turning later to those in which such a regime is required.

1. *The first-mover advantage situation* in which actions that promote CPR preservation have very large individually appropriable benefits to firms or states, which therefore have incentives to move first. The development of green technology that could generate large profits in the future is a possible case in

[20] Victor et al. 2009.
[21] Hardin 1968.
[22] Ostrom 1990; Keohane and Ostrom, eds. 1995; Ostrom, Janssen, and Anderies 2007.

point. "Blockbuster" drugs are a current example of such a situation where analysts assumed that a collective action problem existed (ie, under-investment in supplying the public good of research) that was solved when first movers discovered the potential for earning extra-normal profits. [23] Some of the flood of resources into new energy technologies may be explained by a belief that a new blockbuster mode of industrial organization could prevail in the low-carbon economy. First mover advantages are pervasive in regulated industries. For example, firms often find it easier to obtain collusive outcomes when a few leading firms support the creation of regulatory instruments that raise barriers to entry and stabilize competition.[24]

2. *The CPR co-benefits situation* in which behavior that promotes preservation of the CPR is sufficiently motivated by other benefits to be engaged in without external enforcement or threatened exclusion from a regime. This was true with the ozone regime: substitutes were often cheaper than the ozone-depleting chemicals. In this situation there are incentives to comply although not necessarily to move first. For example, some greenhouse gas emissions – such as those of black carbon – also cause local air pollution and health problems, creating self-interested incentives for governments to limit them.

3. *The CPR benefits exclusion situation* in which there is a hierarchy of power, and actors not promoting preservation of the CPR, or not adopting measures that make CPR-promotion virtually costless to them, can be excluded at low cost from other benefits of the regime by its dominant members. An example is the ocean oil-pollution regime after the implementation of the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1973 and a subsequent protocol in 1978. After MARPOL was in place, compliance with anti-pollution rules rose sharply since non-compliers could be excluded from major ports.[25] In climate change, offering access to rich country carbon markets to countries that implement tighter emission controls and adopt other complementary policies are examples. Such institutional arrangements get the incentives right although there can be resentment and resistance to exclusion.

4. *The small-group reciprocity situation*, in which a small number of identifiable players can monitor one another's behavior and can sanction, through reciprocity, agents that refuse to accept jointly agreed rules or who fail to comply with rules that have been established.[26] The North Pacific Fur Seals treaty offers an example. A small number of countries found it relatively easy to monitor and enforce rules while also excluding others. [27]

[23] Pisano 2002. Of course, realizing these first-mover advantages did require a regime that sufficiently assured protection of intellectual property resources.
[24] Stigler 1971; Peltzman 1989.
[25] Mitchell 1994.
[26] Axelrod 1984; Ostrom 1990; Ostrom 2005.
[27] Barrett 2006.

This variety of situations implies a variety of strategies, focused on different incentive problems. Institutions can be created, or modified, to affect any of the four situations listed above: first-mover advantages, co-benefits, benefits exclusion, and small-group reciprocity.

Policies directed at increasing incentives for first-movers include making intellectual property rights more secure, which often enhances incentives to innovate. Although responding to climate change is a daunting task, technological innovation could largely transform the problem. For example, in the early days of the ozone regime people thought responding to ozone depletion would be a very hard problem. The appearance of new technology, spurred by regulation and lowering the costs of phasing out ozone-depleting chemicals, changed the nature of problem by changing incentives, making a deep and comprehensive regime feasible. [28]

With respect to co-benefits, governments and other actors could design institutions to provide information about co-benefits or provide scientific, technical, and financial help in responding to emissions that damage both local and global environments. Such functions of institutions may be particularly appropriate toward governments that may face constraints of knowledge, finance, and technical skill in implementing measures that could align with local priorities while also yielding global emissions reduction as a beneficial side-effect.[29] In the European acid rain regime, most national policies that contributed to the regional goal (less acid rain) also delivered the benefit of less local air pollution. Most countries that exported some of their pollution were, in fact, also their largest self-polluter.[30]

Much attention has been paid to the crucial issue of excluding free-riders from the benefits of others' efforts to reduce emissions. Coalitions of regime leaders can generate policies to exclude non-contributors from benefits, as in the MARPOL case when non-adherents were excluded from important ports. Applied to the case of climate change, the careful use of border tariff adjustments could compensate for price differentials resulting from differential efforts to cut emissions and, in turn, deter free riding.[31]

Finally, contracting could be made easier, monitoring improved, and specific issues dealt with by small groups of states, so that reciprocity operates better. An important way to improve the operation of monitoring is to ensure that action is taken through a sequence of small steps ("repeat play"), so that each agent's next progressive step is conditional on the last move of her partners. Both trade negotiations and arms control illustrate this point.[32] So far, there are very few examples of reciprocity and repeat play at work in the effort to build institutions on climate change. Partial examples include the EU's effort to create an emission trading system through a series of rounds

[28] Parson 2003.
[29] Rai and Victor 2009.
[30] Levy 1993.
[31] Since there are obvious dangers of opportunistic protectionism with respect to implementing border taxes it would be important to make sure that these measures are linked tightly to the WTO regime and its dispute settlement mechanism. See the WTO-UNEP report, *Trade and Climate Change* 2009.
[32] Axelrod 1984; Axelrod and Keohane 1985.

with rule adjustments at each round. A full blown, permanent trading system would not have been credible in the early 2000s when EU bureaucrats first created the system. Knowing that the key to any market approach is investor confidence, the EU has limited its adjustments in each round with the knowledge that future efforts to convince investors to invest in low-emission technologies will be undermined if present changes in the rules are too onerous or introduce excessive regulatory risk.

The key point is that climate change problems involve diversity "all the way down." Rewiring the incentives to allow effective cooperation on problems whose structure appears uninviting for cooperation will require different approaches to different problems. As Elinor Ostrom and colleagues have emphasized, there are no panaceas.[33] Furthermore, and perhaps more important from a political standpoint, the diversity of plausible approaches will attract a variety of supporters, each attracted to approaches that are aligned with their own interests and beliefs. Powerful interests will skew the chosen approach in their own directions – and there is every reason to believe that these directions will be different in different countries or sectors. World politics is so fragmented and heterogeneous that there is little reason to expect the reflection of world politics in climate change regimes to be more coherent.

Toward Explaining Loose Coupling and Fragmentation

We can now offer a tentative account of why the problem of climate change is likely neither to yield an integrated, comprehensive regime nor to be fully fragmented. Our account seeks to explain the observed outcome of a loosely coupled collection of independent regulatory elements—a "regime complex." Our argument is threefold, including functional, strategic, and organizational components.

From a functional standpoint, as we have emphasized above, the specific problems involved in regulating climate change are so varied that a single institutional response is exceptionally difficult to organize. Indeed, the diversity of problems is typically accompanied by a diversity of complexes of interests, power, information, and beliefs. Where contracting around these individual cooperation problems is coupled to other institutional arrangements it is prohibitively complicated to arrange all couplings *ex ante* into a single comprehensive regime. The framework that we have sketched in this paper emphasizes the role played by the perceived self-interests of states in their decisions. They create institutions to help solve problems of collective action, but they have imperfect information and ability to regulate behavior through those institutions. In turn, these institutions can shape incentives and change what particular interest groups see as their interests.

Our second argument is strategic. On the one hand, specific regimes are often anchored on private goods supplied to a small number of actors whose interests are similar to each other but dissimilar to other actors. These interests are also interdependent because, for example, regulatory decisions affect economic competition. Members of this "club" will then seek to maintain these arrangements for their own

[33] Ostrom, Janssen, and Anderies 2007.

benefit. Interest diversity therefore pushes toward fragmentation. The benefits of a comprehensive regime may not seem sufficient to justify the bargaining efforts and concessions that would be required. On the other hand, a fully fragmented response is unlikely to satisfy the interests of the leading states that make the largest investments in building institutions and which expect first-mover advantages. They will seek linkages among issues.

For example, states that seek deep cuts in emissions must find ways to compensate more reluctant nations that are also formidable economic competitors—mobilizing the needed resources is unlikely through government-to-government transfers, but much larger resources are available through private carbon markets. These leaders will thus couple the compensation regime to emission control regulations that create carbon markets. Efforts to promote greater innovation in low-emission technologies also benefit from loose linkages to effective emission controls in at least some key markets—so that innovators see a market pull for new ideas that can become profitable. Similarly, important linkages have emerged between the system for providing information about climate dangers and emission control efforts. The "Bali Roadmap" that set the agenda for the Copenhagen conference, for example, explicitly used the IPCC's findings about "safe" levels of warming gases in outlining the countries that must participate in efforts to control emissions, broadly, the level of control that would be required.

Our third argument rests on path-dependence and organizational practices. Different countries and sectors have become interested in serious action on climate change at different times. When the timing of action varies, the "leaders" construct partial institutions that suit their purposes and their interests. Once they have done so, they are likely to resist changing these arrangements fundamentally, since it is costly to change organizational structures and state leaders are likely to engage in satisficing behavior so as long as the regime complex performs essential functions passably well.[34]

For example, Europe and Japan have been much more committed to the Kyoto process than most other industrialized countries, including notably the United States. The EU has invested heavily in the construction of international regulatory regimes for climate change that are based on legally binding targets and timetables as well as international emissions trading. In turn, the EU has crafted its own policies at home to align with that international approach. For the EU, different approaches are difficult to envision and implement—even as other countries find that they favor other regulatory schemes not anchored in targets and timetables. It may therefore be easier to build parallel elemental regimes as part of a regime complex than to try to re-open negotiations to achieve a comprehensive, integrated regime. Indeed, the final compromise reached at the Copenhagen conference explicitly creates legal flexibility so that some nations can continue the formal Kyoto legal mechanisms while others (notably the United States) adopt different approaches. And most analysts expect that dispersion to continue as a greater number of countries with diverse interests and capabilities—the developing countries—are more fully engaged in regulation.

[34] Simon 1959.

III. Implications for Policy

As governments attempt to coordinate international institutions on climate change the outcome is unlikely to be an integrated, comprehensive regime. Instead, a regime complex is emerging and likely to persist due to differences in interests, the weak private incentives for leaders to create integrated regimes, lack of strong hierarchical authority in the issue-area, uncertainty about effects, and contrasting beliefs about responsibility for damage. Unlike international rules on trade, which until a decade ago were largely integrated and comprehensive, the incentives for individual governments to orient themselves around a single common set of rules are weak while powerful forces encourage dispersion. Our exploration of implications for policy is rooted in this central observation.

The Advantages of Climate Regime Complexes

We argue that, in the current state of great uncertainty and rapid change, regime complexes are more likely outcomes than an integrated comprehensive regulatory regime. If the integrated, comprehensive regimes that could emerge were viewed as legitimate, adaptive and effective—criteria we explore in more detail below—then such an approach would probably be superior to regime complexes. But any politically feasible comprehensive regime is likely, as with the Kyoto Protocol, have only modest impact on most countries while also creating expectations that are an obstacle to later reforms in light of new information. It is important, therefore, not to compare actual regime complexes with hypothetical but unrealistic comprehensive regimes. From a normative standpoint, regime complexes have some advantages over *politically feasible* integrated, comprehensive regimes. With care, policy makers who seek more effective limitation on the magnitude of climate change can use regime complexes to their advantage.

The potential advantage of regime complexes lies, in part, in the faults of integrated regulatory systems that are already apparent in the UNFCCC and the Kyoto Protocol. These dysfunctions arise in part because it is difficult to design effective systems in the context of extreme uncertainty about what measures governments are willing and able to implement. They also arise because integrated regimes are, by definition, institutional monopolies. Once they exist it is difficult to craft rival institutions. Heroic efforts concentrate on the monopoly; rival efforts, even when they could be more effective, are pilloried as distractions. For example, the broad coalition of developing countries—the G77 and China—lambasted attempts to work in small groups and outside the UNFCCC process at the close of the most recent formal negotiating sessions of the UNFCCC, despite mounting evidence that these formal sessions are making little progress.[35]

[35] Ibrahim 2009.

The dysfunctions of the UNFCCC monopoly are especially evident in two areas. First, perhaps the most important aspect of the Kyoto Protocol is its system for encouraging low-emission investments in developing countries—the CDM. Over the long term, engagement with developing countries is essential since it is mathematically impossible to reach deep cuts in world emissions of warming gases without these countries' participation.[36] Yet studies suggest that a large fraction—perhaps two-thirds or even more—of the CDM credits issued do not represent bona fide reductions in emissions due to poor administration.[37] Despite this realization, it is proving very difficult to fix the CDM within the complex and highly politicized nature of decision-making within the UNFCCC; indeed, there are strong pressures for an even larger supply of credits, rather than higher quality credits. The CDM monopoly has effectively excluded offsets in some areas (e.g., carbon storage and nuclear power) while favoring offsets in areas that may be less cost-effective, such as small, rural renewable energy projects. Since these rules create path dependence, such offsets rules are likely to be transposed into a new comprehensive regime with the result the carbon equivalent of Gresham's law. Allowance for a wider array of offsets, and competition between them for quality, could reverse these perverse incentives.

Secondly, the UNFCCC/Kyoto arrangements for linking national trading systems have encountered difficulties. The Kyoto architects envisioned that national emission control systems could be linked together to form an international trading system. but in practice, the rules for "docking" have proven to be inflexible and do not encourage much additional effort by governments. More flexible docking rules would allow a wider array of countries to sell allowances into established carbon markets, conditional on setting country-wide or sectoral caps, and would therefore broaden the scope of carbon trading systems.[38] Yet it has proved difficult for countries to change their status under the UNFCCC/Kyoto system in ways that would amplify emission controls. Indeed, Kazahkstan has sought for over a decade to join Annex I of the Kyoto Protocol so it can participate in carbon markets; but it has not been permitted to do so.[39] This situation constitutes an example of a situation in which a voluntary action that would contribute to the objective of the Kyoto Protocol is prohibited by procedural barriers and veto-points built into that international agreement.

While institutional monopolies have dysfunctions, a regime complex can also have dysfunctional tendencies, especially if it is highly fragmented. Components may conflict with one another in ways that yield gridlock rather than innovation; the lack of hierarchy among elemental regimes can create critical veto points; through forum-shopping there could in principle be a "race to the bottom." The proponents of comprehensive regimes often rightly point out these dangers in their argument for concentrating climate change diplomacy in the UNFCCC process; and their force helps account for our earlier assertion that in an ideal world comprehensive regimes are more effective than egime complexes. Our argument is not that regime complexes are

[36] Clarke et al. forthcoming.
[37] Schneider 2007; Wara and Victor 2008; Wara 2009.
[38] Petsonk 2009; Wagner et al. 2009; Grubb et al. forthcoming; Stavins, Jaffe, and Ranson forthcoming.
[39] Petsonk 2009.

absolutely better than the best imaginable comprehensive regimes; but that if political reality makes effective and legitimate comprehensive regimes impossible, we should not despair. Indeed, regime complexes have two significant advantages over comprehensive, integrated ones: flexibility across issues and adaptability over time.

Flexibility across issues. Without a requirement that all rules be bound within a common institution, it may be possible to adapt rules to distinctively different conditions on different issues, or for different coalitions of actors. Different states could sign on to different sets of agreements, making it more likely that they would adhere to some constraints on greenhouse gas emissions. One variant of of such a flexible approach involves proposals popular with the Australian, US and several other governments (including key developing countries) that states construct "schedules" of their proposed climate change actions, rather than acceding to a common set of targets and timetables.[40] This approach is similar to the flexibility afforded when large governments engage in complex negotiations to accede to the WTO; each country's particular accession deal is tailored to its circumstances.[41] This approach was tried early in the climate change process under the heading of "pledge and review" but that idea lost favor when no government made the effort to flesh out how the concept would work in practice and the governments and interest groups most keen on emission controls—notably in the EU governments and NGOs—favored simpler targets and timetables for emissions.[42]

Adaptability over time. Regime complexes may also have higher adaptability over time. Change in different issue-areas, or within the domestic politics of different countries, may take place at different rates. In contrast with integrated, tightly coupled monopoly institutions, regime complexes may be able to adapt more readily—especially when adaptation requires complex changes in norms and behavior. Loose coupling may also be advantaged when the best strategy for adaptation is unclear and thus many diverse efforts should be tried and the more effective ones selected through experience. Applied to climate change, this benefit is probably particularly important for engaging developing countries that are wary about obligations that could become too onerous too quickly, but the particular fears vary with each country and its circumstances. The creation of the EU benefitted, in part, from flexibility to allow for "multi speed" coordination of policy—under a common (at times leaky) umbrella of the common market and burgeoning EU law the many members of the EU moved at quite different rates.

These advantages of greater flexibility and adaptability stem, in part, from decision-making structures. In global institutions such as the UN, in particular, universal voting rules often yield inaction. For example, for years the UNFCCC did not have formal procedures for voting on decisions because the decision to adopt those procedures required unanimous consent and oil-exporting countries (a group generally abhorrent to policies that would cut consumption of carbon fuels) refused to agree. Leaders are needed

[40] The Minister for Climate Change and Water of Australia, Penny Wong, made this argument in a speech at New York University, September 21, 2009.
[41] e.g., Michalopoulos 2002.
[42] Victor 2009. The present authors do not have the same view on the merits of "pledge and review," so we jointly take no stand on that question.

to incur the cost of organizing an effective response to CPR problems, yet those few leaders who are willing and able to commit adequate resources may refuse to make the effort unless they can capture a large share of the benefits. Decision-making structures initiated by interested states enable these leaders to achieve this objective.

Variation in Regime Complexes: Criteria for Assessment

The advantages we have noted for a regime complex do not arise automatically. Indeed, dispersed institutions can also be associated with chaos, a proliferation of veto points and gridlock that deters policy makers and private investors from devoting resources to the climate change problem. Proposals for elemental regimes that would further fragment climate institutions should therefore be carefully analyzed to see whether they are performing as well as could feasibly be expected. Whether the proliferation of different forums working on the climate issue—such as the G20, the MEF, various bilateral technology and investment partnerships, and private sector and NGO initiatives—is an asset or liability depend on how these efforts are coupled.

Regime complexes can be evaluated on the basis of six criteria. Along the dimension defined by each criterion, there is variation running from dysfunctional to functional. Regime complexes toward the positive end of each of the five dimensions are likely to be more effective than complexes that score lower, on balance, on these dimensions.[43]

1) *Coherence.* The various elemental regimes of a climate change regime complex could be compatible and mutually reinforcing; they could be incompatible and mutually harmful; or they could be somewhere in-between these extremes. A regime whose components are compatible and mutually reinforcing is coherent.
2) *Accountability.* The elements of the regime complex should be accountable to relevant audiences, including not just states but non-governmental organizations and publics. Accountability means that "some actors have the right to hold other actors to a set of standards, to judge whether they have fulfilled their responsibilities in light of these standards, and to impose sanctions if they determine that these responsibilities have not been met"[44].
3) *Effectiveness.* A climate change regime complex could be more or less effective. Effectiveness requires a reasonable level of compliance with rules, but also requires appropriate rules. More effective regimes create more net benefits for members than less effective ones.
4) *Determinacy.* A climate change regime complex could be determinate in the sense that the rules have "a readily ascertainable normative content."[45] Or it could be less determinate or even quite indeterminate. Since uncertainty is the enemy of long-term planning, such as required for costly investments in fixed

[43] Buchanan and Keohane 2006.
[44] Grant and Keohane 2005, 29.
[45] Franck 1990, 52.

low-emission infrastructures, determinacy is a virtue on issues such as climate change that require long-term investment.

5) *Sustainability.* A climate change regime could contain a set of elemental regimes that each represents a coherent equilibrium point for the relevant set of issues. Such a regime is likely to be politically sustainable in that it would require large shocks to destroy or fundamentally alter it. Sustainable regimes are superior since they reduce uncertainty, in this case about future rules.
6) *Epistemic quality.* Like comprehensive regimes, regime complexes can vary in epistemic quality: that is, in the consistency between their rules and scientific knowledge; the accountability of their managers; and their capacity to revise both their rules and their terms of accountability.[46]

The climate change regime complex of 1997-2008, dominated by the institutions established by the Kyoto Protocol, does not get high rankings on any of these six criteria. The division of countries under Kyoto into industrialized ("Annex I") and developing ("non-Annex I") countries implied a regime of low coherence and accountability in which the absence of binding rules for some economically competitive units reduced incentives for others to accept such rules and made it impossible to hold many states accountable for their actions. The Kyoto treaty and its parent, the United National Framework Convention on Climate Change, contain no credible compliance mechanisms and, unlike WTO, no mandatory dispute-settlement institutions, which reduce their effectiveness and determinacy. The dissatisfaction of the United States, and potentially of other developed countries, threatened its sustainability. Finally, modest impact of the rules on total world emissions along with the difficulty of changing the rules and the highly political process limited the epistemic quality of the regime complex. In light of these defects, it is not surprising that while most countries joined the Kyoto regime because membership required little effort, overall the treaty did not command widespread support, particularly in many of the wealthy Annex I countries. Nor was Kyoto an attractive model for the rapidly developing countries that would be expected to undertake emission controls in the periods after the Kyoto treaty expired.

These six dimensions can offer guidance not only for those who attempt to design a comprehensive post-Kyoto regime, but also for policy makers who understand that climate institutions will include a complex of loosely coupled elements rather than a single, integrated scheme. For these policy makers, the task is to invest in initiatives that score well on these dimensions.

[46] Buchanan and Keohane 2006, 424-433.

Specific Implications for Policy

Finally, we draw several implications for policy. We focus on actions that leading governments, NGOs and firms could pursue in efforts to make a regime complex more effective.

First, a regime complex could favor more effective use of international emission trading. Trading has become the policy instrument of choice for nearly all governments that are implementing the most demanding policies. Well-designed trading systems could be very important because they leverage large amounts of capital and because some of that capital could flow to developing countries through "offsets" such as the CDM. The CDM, for all its flaws, has already generated emission credits worth perhaps ten times the value of classic government-to-government funding.

At present, the attempts to create an integrated UNFCCC/Kyoto regime have yielded only one set of accounting procedures and offsets rules to govern which kinds of international trades get formal credit. A more competitive system, with a multitude of rules, would be more effective. Governments in industrialized countries that are most interested in controlling emissions could set their own offset rules—tighter than the CDM—and open trading windows to any other country with equally strict (or stricter) offset policies. Rules requiring buyers to be liable for the quality of the credits they purchase would create additional incentives for quality as well as new pricing mechanisms so that markets could assess and reward the highest quality trading. In turn, a diversity of offsets rules would yield a much wider array of real experience that could inform future efforts to create common rules and common "floor" standards. Within a regime complex there would be many different trading systems with different prices, trading rules, and transaction volumes.[47] International offsets could become the arbitrage points that link those trading systems.

Second, a loosely coupled system could create special opportunities for innovation around offsets for land use and forestry. Land use is a large source of warming emissions and also potentially a very low cost way to absorb extra emissions from the atmosphere. However, in Kyoto these issues were so controversial that governments could not agree to allow much investment in land use and forestry projects—the forested nations, especially, feared intrusion on their national policies. Now that the CDM has demonstrated that capital flows through offsets are credible those same nations—notably Brazil and Indonesia—have reversed course and favor more liberal offsets rules. At this writing it is not clear how best to structure, monitor and enforce international land use and forestry offsets and governments are struggling through the Copenhagen process to devise a single set of common rules. A more diverse approach would yield more information and would help avoid the outcome already evident in the CDM that central rules in the face of uncertainty and strong private incentives to cheat do not inspire much real investment in emission controls.

[47] Victor, House, and Joy 2005.

Third, a regime complex would be able to accommodate border tax adjustments (BTAs). Many analysts are wary of such schemes because they fear that BTAs could lead to trade discrimination that, in turn, will undermine successful cooperation in other areas, notably the WTO and other trade liberalization agreements. We share some of that concern, but we note that border tariffs make it possible to create private goods, thus increasing incentives for countries to dock into a carbon trading system to avoid imposition of BTAs. Furthermore, BTAs could be politically important in countries that were considering establishing and maintaining carbon trading systems, by providing assurances that regulatory efforts at home will not erode investment and jobs. Hence from a political perspective – both international and domestic – BTA's are attractive instruments. Yet BTA's are only feasible within a regime complex since opposition to such policies by developing countries assures that any formal effort to negotiate BTAs as part of an integrated, comprehensive climate regime would be vetoed.

The likelihood that properly designed border tax adjustments could pass WTO tests is much enhanced by a recent joint report from the World Trade Organization and the UN Environment Program.[48] This report suggests that BTA's must meet three conditions: (1) a close connection between the means employed and essential climate change policy; and (2) non-discriminatory application, so that the measure does not serve as "a disguised restriction on international trade"; and 3) respect for administrative due process, as has been required on other issues by the WTO Appellate Body. That is, BTAs could be legal by WTO rules if they are properly designed and implemented. We suggest that policy makers within the most active climate clubs devise rules for BTAs that are consistent with these guidelines, in an effort to avoid conflict with WTO rules.

Fourth, and finally, a regime complex offers the flexibility for cooperation on policies that could complement the central task of cutting emissions. Paramount among those is investment in technology. Under the UNFCCC/Kyoto Process there have been some halting efforts to promote investment in technology, but these efforts have not had any practical effect on national technology policies. Smaller clubs of leading governments could agree to coordinate and amplify their investment in technology—some of the needed investment is now in place through economic stimulus programs, but those will be short-lived and remain poorly coordinated. While the incentive to craft and coordinate technology policies in the UNFCCC/Kyoto system is weak, within a club the benefits would be more visible as would the potential for private goods such as intellectual property and revenues from larger markets.

Success in the formation of innovation clubs will, in time, make most aspects of the climate change problem easier to solve. Successful innovation of inexpensive low-emission technologies will lower the cost of emission controls. Indeed, the central cause of success in the ozone layer regime was the appearance of new technologies at very low (sometimes essentially zero) cost. Difficult CPR problems are made much easier when low cost technologies blunt the incentives to defect and when new technologies offer many local benefits (e.g., improved energy security and lower local pollution).

[48] WTO-UNEP 2009. See also Hufbauer, Charnovitz, and Kim 2009.

Furthermore, the emergence of a belief system around the prospects of "clean tech" revolutions and green jobs could also help mobilize new interest groups that favor effective climate policy But this belief system will only be sustainable, and worthwhile in the long run, if it is seen as realistic and a reliable source of private benefits.[49]

As a practical matter, keener interest in technology would require the leading innovators to coordinate much larger national investments in innovation. While new knowledge is a global public good, systems of innovation are organized at the national and sectoral levels. The good news is that an innovation club should be relatively easy to organize since only six countries account for about 85% of all R&D investment.[50] The bad news is that spending on energy technology has not even recovered to the levels seen in the early 1980s. Spending is rising at present, but some of that new money is linked to economic stimulus programs that, presumably, will end in the next couple years. A new technology strategy is needed that would include not only coordination of national investment levels but also sharing of experiences about the best organization for innovation. A perennial danger with energy technology programs is poor design; indeed, so-called "technology pork barrels" plagued the biggest programs of the late 1970s and early 1980s and efforts will be needed to marry the political requirement of private goods (including pork) with the public goal of spurring innovation. [51]

As we have emphasized, our argument for the advantages of a regime complex for climate change is conditional on our belief that the first-best possibility – a coherent, effective, and legitimate comprehensive regime, with sufficient flexibility to accommodate needed change in response to new situations and information – is politically unattainable. Even given this assumption, however, the UNFCCC would still have an important role to play in a climate regime complex. Acceptance of the existence of a regime complex—and policy efforts to exploit some of the advantages of a more flexible and adaptable regime complex—does not make the UNFCCC irrelevant. However, it does shift the UNFCCC's role and makes it only one component of the entire regime complex.

The Framework Convention would best be used as an umbrella under which many different efforts proceed. It would supply functions that are best provided on a universal basis, such as standards for reporting on emissions, providing a forum for negotiating broad decisions, and perhaps instructing technical bodies (e.g., the IPCC) to gather and assess information. At present, however, the list of functions for the

[49]We are mindful that the widespread belief that spending on green technology will yield jobs and economic growth is still to be proven. For a skeptical view see Kahn 2009. Moreover, while green jobs will surely appear many of them will occur in the global economy where it is difficult to concentrate in the jurisdictions that are first movers.

[50] This list includes the United States, Japan, China and a few European countries. China is on the list today and is rising rapidly; a decade ago it was a bit player in innovation.

[51] Measuring R&D effort is difficult, and there are no reliable data on the world effort in energy. For total world spending on all forms of R&D see OECD 2008, which ranks the top spenders at U.S., Japan, China, Germany, France and the U.K. (If the EU is summed as a whole then it ranks second behind the U.S.). On the R&D problem in energy see Dooley 1998 among others. For a seminal warning about pork in large energy demonstration projects see Cohen and Noll 1991.

UNFCCC is fairly narrow because the most sensitive functions—for example, assessment and enforcement of compliance and resolution of disputes—must be integrated into substantive commitments. Such functions are most important when commitments are deep, but the UNFCCC is too broad and inflexible to allow for deep commitments.

Over time, the UNFCCC might evolve into a deeper institution and perhaps the core of an integrated regulatory system. With experience, for example, it is possible that a wide array of "club" efforts under way presently could be governed by common rules—akin, perhaps, to most favored nation status and reciprocity in the GATT/WTO system, which help ensure that particular club deals crafted on trade are generalized to a larger number of countries. But we caution against policy efforts that would move too quickly in that direction. Managing common-pool resources is unlike the more reciprocal task of reducing barriers to trade in good and services. It is harder to internalize the benefits from CPR action; exclusivity that comes from clubs is thus a particularly important incentive for first movers to invest in building institutions.

IV. Conclusion

The international rules and institutions that regulate issues related to climate change are diverse in membership and content. They have been created at different times, and by different groups of countries. They are not integrated, comprehensive, or arranged in a clear hierarchy. They form a loosely linked regime complex rather than a single international regime. In the language of this paper, the regime complex for climate change consists of a number of loosely coupled specific regimes, as described in Figure 1.

Regime complexes arise for functional, strategic, and organizational reasons, as discussed in Part II. The functional reasons for regime complexes are closely linked to strategic ones, since different bargaining dynamics, and political coalitions, arise around different functional solutions. Even with respect to CPR and public goods problems there is significant variation in problem type. The perverse incentives inherent in CPR problems can be altered in a variety of ways: through first-mover advantages, achieving co-benefits, excluding non-payers from benefits, and small-group reciprocity. Each of these situations may imply different institutions supported by different political coalitions and therefore with different membership. Many of these efforts are easier to mobilize in clubs rather than universal settings. Finally, there are organizational reasons for regime complexes: Once these clubs have been created, the interests of their memberships may diverge from each other further than functional arguments alone would suggest.

Changes in regime complexes—like all institutions--take place principally as a result of changes in material interests, power, information, and beliefs. In regime complexes these changes affect, in the first instance, the more narrow elemental regimes. They can lead to tension among these elemental regimes, creating pressure to resolve conflicts at the joints and often causing further shifts to the fragmented end of the continuum referred to above. Historical contingency and path-dependence also play a

role: certain patterns of behavior can be locked-in because of their couplings with other patterns of behavior that are hard to change.

In Part III we turned to policy issues, arguing that regime complexes have some distinctive advantages over the politically feasible set of integrated, comprehensive regimes. We admit that severe fragmentation – when the elements of a regime complex conflict with one another – is likely to degrade the long-term performance of the regime complex overall, and that regime complexes can be dysfunctional. But when compared with integrated-comprehensive regimes as they actually exist, they have some advantages. They can be much more flexible and adaptable than integrated-comprehensive regimes such as the FCCC-Kyoto regime, which in some ways has hindered constructive policy change. The Clean Development Mechanism and the Kyoto "docking" rules illustrate the counterproductive rigidities that can be built-into comprehensive regimes and that become hard to change due to vested interests.

From a normative standpoint, we suggest six criteria for the evaluation of regime complexes: coherence, accountability, effectiveness, determinacy, sustainability, and epistemic quality. Different loosely linked regime complexes may score differently on these criteria. It is therefore not enough to argue that loosely linked regime complexes may be superior to integrated-comprehensive ones, but it is necessary also to specify which patterns of loose linkage combine political feasibility with potential for effectiveness.

Whether loosely linked climate regimes will be more effective than efforts to craft a single integrated regime depends, in part, on decisions by policy-makers. Although a comprehensive global trading system is unlikely, much emissions reduction could be achieved through a linked set of national and regional trading systems, in which offsets would play an important and positive role. A loosely linked regime complex would allow for experimental innovation with respect to land use forest offsets, as in present initiatives to reduce deforestation. It could also enable border tax adjustments to be used in selected situations, and linked to the WTO dispute settlement regime. Finally, technology innovation clubs could use private incentives to leverage research and investments that would make limiting emissions more feasible and less costly.

In such a regime complex, the UNFCCC would continue to play an umbrella role, and to provide the framework for a number of essential functions, including serving as a legal setting, providing information, and constituting a forum for negotiations. Over time, if convergence in policy preferences took place, the UNFCCC could yet evolve into an integrated and comprehensive policy regime. At the present juncture, however, both political reality and the need for flexibility and diversity suggest that it is preferable to work for a loosely linked but effective regime complex for climate change.

References

Alter, Karen J., and Sophie Meunier. 2009. The Politics of International Regime Complexity. Symposium. *Perspectives on Politics* 7 (1): 13-24.

Axelrod, Robert. 1984. *The Evolution of Cooperation.* New York: Basic Books.

Axelrod, Robert, and Robert O. Keohane. 1985. Achieving Cooperation under Anarchy: Strategies and Institutions. *World Politics* 38 (1): 226-54.

Barrett, Scott. 2006. *Environment and Statecraft: The Strategy of Environmental Treaty-Making*. New York: Oxford University Press.

Braithwaite, John, and Peter Drahos. 2000. *Global Business Regulation.* Cambridge, Mass.: Cambridge University Press.

Buchanan, Allen, and Robert O. Keohane. 2006. The Legitimacy of Global Governance Institutions. *Ethics and International Affairs* 20 (4): 405-37.

Busch, Marc L. 2007. Overlapping Institutions, Forum Shopping, and Dispute Settlement in International Trade. *International Organization* 61 (4): 735-61.

California Air Resources Board. 2009. *Preliminary Draft Regulation for a California Cap-and-Trade Program*, November 24.

Clarke, Leon, et al. Forthcoming. International Climate Policy Architectures: Overview of the EMF 22 International Scenarios. *Energy Economics.*

Cohen, Linda R., and Roger Noll. 1991. *The Technology Pork Barrel.* Washington: Brookings Institution Press.

Cornes, Richard, and Todd Sandler. 1996. *The Theory of Externalities, Public Goods, and Club Goods.* 2nd ed. New York: Cambridge University Press.

Dooley, James J. 1998. Unintended Consequences: Energy R&D in a Deregulated Energy Market. *Energy Policy* 26 (7): 547-55.

Franck, Thomas. 1990. *The Power of Legitimacy among Nations.* New York: Oxford University Press.

Grant, Ruth W., and Robert O. Keohane. 2005. Accountability and Abuses of Power in World Politics. *American Political Science Review* 99 (1): 29-43.

Grubb, Michael, et al. Forthcoming. Global Carbon Mechanisms: Lessons and Implications. *Climatic Change*.

Hardin, Garrett. 1968. The Tragedy of the Commons. *Science* 162: 1243-48.

Hufbauer, Gary C., Steve Charnovitz, and Jisun Kim. 2009. *Global Warming and the World Trading System*. Washington: Peterson Institute for International Economics.

Ibrahim, Ibrahim Mirghani. Statement on Behalf of the Group of 77 and China by H.E. Ambassador Ibrahim Mirghani Ibrahim, Head of Delegation to the Republic of Sudan, at the Closing Plenary of the Resumed Ninth Session of the Ad Hoc Working Group under the Kyoto Protocol (AWG-KP 9), 6 November 2009, Barcelona, Spain.

Kahler, Miles, and David A. Lake. 2003. *Governance in a Global Economy: Political Authority in Transition.* Princeton, N.J.: Princeton University Press.

Kahn, Matthew. 2009. Think Again: The Green Economy. *Foreign Policy* May/June.

Keohane, Robert O. 1984. *After Hegemony: Cooperation and Discord in the World Political Economy*. Princeton, N.J.: Princeton University Press.

Keohane, Robert O., and Joseph S. Nye, Jr. 1977. *Power and Interdependence.* 3rd ed 2001. New York: Addison Wesley Longman.

---. 2001. The Club Model of Multilateral Cooperation and Problems of Democratic Legitimacy. In *Efficiency, Equity, Legitimacy: The Multilateral Trading System at the Millennium*, edited by Roger Porter, Pierre Sauvé, Arvind Subramanian, and Americo Beviglia Zampetti, 264-94. Washington: Brookings Institution.

Keohane, Robert O., and Elinor Ostrom, eds. 1995. *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains.* London: Sage Publications.

Levy, Marc A. 1993. European Acid Rain: The Power of Tote-Board Diplomacy. In *Institutions for the Earth: Sources of Effective International Environmental Protection*, edited by Peter M. Haas, Robert O. Keohane, and Marc A. Levy, 75-132. Cambridge, Mass: MIT Press.

Michalopoulos, Constantine. 2002. WTO Accession. In *Development, Trade and the WTO: A Handbook*, edited by Bernard M. Hoekman, Aaditya Mattoo, and Philip English, 61-70. Washington: The World Bank.

Michonski, Katherine E., and Michael A. Levi. 2010. *The Regime Complex for Global Climate Change.* New York: Council on Foreign Relations.

Mitchell, Ronald. 1994. *Intentional Oil Pollution at Sea: Environmental Policy and Treaty Compliance.* Cambridge, Mass.: MIT Press.

O'Neill, Barry. 1999. *Honor, Symbols, and War.* Ann Arbor, Mich.: University of Michigan Press.

Organization for Economic Cooperation and Development. 2008. *Main Science and Technology Indicators* 2008/2. Paris: OECD.

Ostrom, Elinor. 1990. *Governing the Commons*. Cambridge, Mass.: Cambridge University Press.

---. 2005. *Understanding Institutional Diversity.* Princeton, N.J.: Princeton University Press.

Ostrom, Elinor, Marco A. Janssen, and John M. Anderies. 2007. Going Beyond Panaceas Special Feature. *Proceedings of the National Academy of Sciences* 104 (39): 15176-78.

Parson, Edward A. 2003. *Protecting the Ozone Layer: Science and Strategy*. New York: Oxford University Press.

Peltzman, Sam. 1989. The Economic Theory of Regulation after a Decade of Deregulation. *Brookings Papers on Economic Activity: Microeconomics* 1989: 1-41.

Petsonk, Annie. 2009. Docking Stations: Designing a More Open Legal and Policy Architecture for a Post-2012 Framework to Combat Climate Change. *Duke Journal of Comparative and International Law* 19 (3): 433-66.

Pierson, Paul. 2000. Increasing Returns, Path Dependence, and the Study of Politics. *American Political Science Review* 94 (2): 251-67.

Pisano, Gary P. 2002. Pharmaceutical Biotechnology. In *Technological Innovation & Economic Performance*, edited by Benn Steil, David G. Victor and Richard R. Nelson, 347-66. Princeton, N.J.: Princeton University Press,.

Rai, Varun, and David G. Victor. 2009. Climate Change and the Energy Challenge: A Pragmatic Approach for India. *Economic and Political Weekly* 44 (31): 78-85.

Ramanathan, V., and G. Carmichael. 2008. Global and Regional Climate Changes due to Black Carbon. *Nature Geoscience* 1: 221-7.

Raustiala, Kal, and David Victor. 2004. The Regime Complex for Plant Genetic Resources. *International Organization* 58 (2): 277-310.

Schneider, Lambert. 2007. Is the CDM Fulfilling its Environmental and Sustainable Development Objectives? An Evaluation of the CDM and Options for Improvement. Öko-Institut report prepared for WWF, Berlin: Öko-Institut.

Simon, Herbert A. 1959. Theories of Decision-Making in Economics and Behavioral Science. *American Economic Review* 49 (3): 253-83.

Slaughter, Anne-Marie. 2004. *A New World Order*. Princeton, N.J.: Princeton University Press.

Stavins, Robert, Judson Jaffe, and Matthew Ranson. Forthcoming. Linking Tradable Permit Systems: A Key Element of Emerging International Climate Policy Architecture. *Ecology Law Quarterly*.

Stigler, George. 1971. The Theory of Economic Regulation. *The Bell Journal of Economics and Management Science* 2 (1): 3-21.

Velders, Guus J.M., et al. 2007. The Importance of the Montreal Protocol in Protecting Climate. *Proceedings of the National Academy of Sciences* 104 (12): 4814-19.

Victor, David G. 2001. *Collapse of the Kyoto Protocol and the Struggle to Slow Global Warming*. Princeton, N.J.: Princeton University Press.

---. 2009. Plan B for Copenhagen. *Nature* 461 (7262): 342-4.

Victor, David G., Joshua C. House, and Sarah Joy. 2005. A Madisonian Approach to Climate Policy. *Science* 309 (5742): 1820-1.

Victor, David G., et al. 2009. The Geoengineering Option: A Last Resort Against Global Warming? *Foreign Affairs* 88 (2): 64-76.

Wagner, Gernot, et al. 2009. Docking into a Global Carbon Market: Clean Investment Budgets to Finance Low-Carbon Economic Development. In *The Economics and Politics of Climate Change*, edited by Dieter Helm and Cameron Hepburn, New York: Oxford University Press.

Wara, Michael. 2009. Methods of Cost Containment in a Greenhouse Gas Emissions Trading Program. Testimony to U.S. Senate Committee on Energy and Natural Resources, 15 Sept 2009.

Wara, Michael W., and David G. Victor. 2008. *A Realistic Policy on International Carbon Offsets*. Working Paper 74. Stanford, Calif.: Program on Energy and Sustainable Development, Stanford University.

World Bank. 2008. *Development and Climate Change: A Strategic Framework for the World Bank Group*. Washington: The World Bank.

World Bank Independent Evaluation Group. 2009. *Climate Change and the World Bank Group. Phase I: An Evaluation of World Bank Win-Win Energy Policy Reforms*. Washington: The World Bank.

World Trade Organization and United Nations Environmental Program. 2009. *Trade and Climate Change: WTO-UNEP Report*. Geneva: WTO.

Young, Oran R. 1997. *Global Governance: Drawing Insights from the Environmental Experience*. Cambridge, Mass.: MIT Press.